

WHAT IS CLAIMED IS:

1. A metal complex having the formula  $LMXZ_n$ , wherein M is selected from the group consisting of Cu, Ag and Au; X is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl, 5  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through  $C_{12}$  cycloalkyl,  $C_3$  through  $C_{12}$  cycloalkoxy, aryl, thiolate, nitrate, sulfate, nitrile, hydroxide and any other moiety into which a monomer can insert; Z is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl,  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through 10  $C_{12}$  cycloalkyl,  $C_3$  through  $C_{12}$  cycloalkoxy, aryl, thiolate, carbon monoxide, nitrate, nitrile, hydroxide, sulfate, olefins, water, any other neutral coordinating ligand and any other moiety into which a monomer can insert; n equals 0, 1 or 2; and L is a multi-dentate nitrogen-containing ligand.

2. The composition according to claim 1 wherein M is Cu.

15 3. The metal complex according to claim 1 wherein for each occurrence of Z, each Z is independently selected from the group consisting of diethylether, tetrahydrofuran, acetonitrile, benzonitrile, dioxane, acetone, 2-butanone, phenylisocyanate, ethylene, carbon monoxide, 1-hexene and norbornene.

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4. The composition according to claim 1 wherein L is a tri-dentate nitrogen-containing ligand.

25 5. The composition according to claim 4 wherein L is selected from the group consisting of 2,2':6',2"-terpyridine, [2,6-bis(1-

phenylimino)ethyl]pyridine, 1,4,7-triazacyclononane, and their substituted derivatives.

6. A catalyst composition comprising the reaction product of:

5 (a) a metal complex having the formula  $LMXZ_n$ , wherein M is selected from the group consisting of Cu, Ag and Au; X is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl,  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through  $C_{12}$  cycloalkyl,  $C_3$  through  $C_{12}$  cycloalkoxy, aryl, thiolate, nitrate, sulfate, nitrile, hydroxide and any other moiety into which a monomer can insert; Z is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl,  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through  $C_{12}$  cycloalkyl,  $C_3$  through  $C_{12}$  cycloalkoxy, aryl, thiolate, carbon monoxide, nitrate, nitrile, hydroxide, sulfate, olefins, water, any other neutral coordinating ligand and any other moiety into which a monomer can insert; n equals 0, 1 or 2; and L is a multi-dentate nitrogen-containing ligand; and (b) an activating cocatalyst.

10 7. The composition according to claim 6 wherein M is Cu.

15 8. The composition according to claim 6 wherein for each occurrence of Z, each Z is independently selected from the group consisting of diethylether, tetrahydrofuran, acetonitrile, benzonitrile, dioxane, acetone, 2-butanone, phenylisocyanate, ethylene, carbon monoxide, 1-hexene, and norbornene.

20 25 9. The composition according to claim 6 wherein L is a tri-dentate

nitrogen-containing ligand.

10. The composition according to claim 9 wherein L is selected from the group consisting of 2,2':6',2'-terpyridine, [2,6-bis(1-  
5 phenylimino)ethyl]pyridine, 1,4,7-triazacyclononane, and their substituted derivatives.

11. The composition according to claim 6 wherein the activating cocatalyst is selected from the group consisting of alkylaluminoxanes, aluminum 10 alkyls, aluminum halides, alkyl aluminum halides, Lewis acids other than any of the foregoing, alkylating agents, and mixtures thereof.

12. The composition according to claim 11 wherein the activating cocatalyst is methylaluminoxane.

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13. A method for polymerizing olefinic monomers, comprising the steps of:

(a) forming an activated catalyst compound by contacting a metal complex having the formula  $LMXZ_n$  with an activating cocatalyst, wherein M is selected from the group consisting of Cu, Ag and Au; X is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl,  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through  $C_{12}$  cycloalkyl,  $C_3$  through  $C_{12}$  cycloalkoxy, aryl, thiolate, nitrate, sulfate, nitrile, hydroxide and any other moiety into which a monomer can insert; Z is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl,  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through 20 25

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100

C<sub>12</sub> cycloalkyl, C<sub>3</sub> through C<sub>12</sub> cycloalkoxy, aryl, thiolate, carbon monoxide, nitrate, nitrile, hydroxide, sulfate, olefins, water, any other neutral coordinating ligand and any other moiety into which a monomer can insert; n equals 0, 1 or 2; and L is a multi-dentate nitrogen-containing ligand; and

5 (b) contacting the activated catalyst compound with one or more olefinic monomers selected from the group consisting of:

- (i) aliphatic olefins,
- (ii) olefins having a hydrocarbyl polar functionality, and
- (iii) mixtures of at least one olefin having a hydrocarbyl polar functional group and at least one aliphatic olefin.

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14. The method according to claim 13 wherein M is Cu.

15. The method according to claim 13 wherein for each occurrence of Z, each Z is independently selected from the group consisting of diethylether, tetrahydrofuran, acetonitrile, benzonitrile, dioxane, acetone, 2-butanone, phenylisocyanate, ethylene, carbon monoxide, 1-hexene and norbornene.

16. The method according to claim 13 wherein L is a tri-dentate 20 nitrogen-containing ligand.

17. The method according to claim 16 wherein L is selected from the group consisting of 2,2':6',2''-terpyridine, [2,6-bis(1-

phenylimino)ethyl]pyridine, 1,4,7-triazacyclononane, and their substituted derivatives.

18. The method according to claim 13 wherein the activating  
5 cocatalyst is selected from the group consisting of alkylaluminoxanes, aluminum alkyls, aluminum halides, alkyl aluminum halides, Lewis acids other than any of the foregoing, alkylating agents, and mixtures thereof.

19. The method according to claim 18 wherein the activating  
10 cocatalyst is methylaluminoxane.

20. The method of claim 13 wherein the contacting steps are performed at a temperature range of from about -100°C to about 250°C and at a pressure range of from about 15 psig to about 30,000 psig.

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21. The method of claim 13 wherein the contacting step is conducted in a solvent.

22. The method of claim 21 wherein the solvent is selected from the  
20 group consisting of an aliphatic hydrocarbon solvent, an aromatic hydrocarbon solvent, a halogenated aromatic solvent, and mixtures thereof.

23. The method of claim 13 wherein said olefinic monomers are selected from the group consisting of acyclic aliphatic olefins and olefins having a hydrocarbyl polar functionality, wherein a homopolymer is formed.

5 24. The method of claim 13 wherein said olefinic monomers are selected from mixtures of at least one olefin having a hydrocarbyl polar functionality and at least one acyclic aliphatic olefin, wherein a copolymer is formed.

10 25. The method of claim 13 wherein said olefinic monomers are ethylene, propylene and 1-butene.

26. The method of claim 13 wherein said olefinic monomers are *n*-butyl acrylate and *t*-butyl acrylate.

15 27. The method of claim 13 wherein said olefinic monomers are ethylene and *n*-butyl acrylate.

28. The method of claim 13 wherein said olefinic monomers are 20 ethylene and *t*-butyl acrylate.

29. A method for polymerizing olefinic monomers, comprising contacting the following compounds *in situ*:

5 (a) a metal compound  $MXZ_n$ , wherein:

(i) M is selected from the group consisting of Cu, Ag and Au,

(ii) X is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl,  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through  $C_{12}$  cycloalkyl,  $C_3$  through  $C_{12}$  cycloalkoxy, aryl, thiolate, nitrate, sulfate, nitrile, hydroxide and any other moiety into which a monomer can insert, and

10 (iii) Z is selected from the group consisting of halide, hydride, triflate, acetate, borate,  $C_1$  through  $C_{12}$  alkyl,  $C_1$  through  $C_{12}$  alkoxy,  $C_3$  through  $C_{12}$  cycloalkyl,  $C_3$  through  $C_{12}$  cycloalkoxy, aryl, thiolate, carbon monoxide, nitrate, nitrile, hydroxide, sulfate, olefins, water, any other neutral coordinating ligand and any other moiety into which a monomer can insert, wherein n equals 0, 1 or 2;

15 (b) a compound L comprising a multi-dentate nitrogen-containing ligand;

(c) an activating cocatalyst; and

(d) one or more olefinic monomers selected from the group consisting of:

20 (i) aliphatic olefins,

(ii) olefins having a hydrocarbyl polar functionality, and

(iii) mixtures of at least one olefin having a hydrocarbyl polar functional group and at least one aliphatic olefin.

30. The method of claim 29 wherein L is a tri-dentate nitrogen-containing ligand.

31. The method of claim 30 wherein L is selected from the group  
5 consisting of 2,2':6',2'-terpyridine, [2,6-bis(1-phenylimino)ethyl]pyridine,  
1,4,7-triazacyclononane, and their substituted derivatives.

32. The method according to claim 29 wherein M is Cu.

10 33. The method according to claim 29 wherein for each occurrence of  
Z, each Z is independently selected from the group consisting of diethylether,  
tetrahydrofuran, acetonitrile, benzonitrile, dioxane, acetone, 2-butanone,  
phenylisocyanate, ethylene, carbon monoxide, 1-hexene and norbornene.

15 34. The method of claim 29 wherein the activating cocatalyst is  
selected from the group consisting of alkylaluminoxanes, aluminum alkyls,  
aluminum halides, alkyl aluminum halides, Lewis acids other than any of the  
foregoing, alkylating agents, and mixtures thereof.

20 35. The method of claim 34 wherein the activating cocatalyst is  
methylaluminoxane.

36. The method of claim 29 wherein the contacting step is performed

at a temperature range of from about -100°C to about 250°C and at a pressure range of from about 15 psig to about 30,000 psig.

37. The method of claim 29 wherein the contacting step is conducted  
5 in a solvent.

38. The method of claim 37 wherein the solvent is selected from the group consisting of an aliphatic hydrocarbon solvent, an aromatic hydrocarbon solvent, a halogenated aromatic solvent, and mixtures thereof.

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39. The method of claim 29 wherein said olefinic monomers are selected from the group consisting of acyclic aliphatic olefins and olefins having a hydrocarbyl polar functionality, wherein a homopolymer is formed.

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40. The method of claim 29 wherein said olefinic monomers are selected from mixtures of at least one olefin having a hydrocarbyl polar functionality and at least one acyclic aliphatic olefin, wherein a copolymer is formed.

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41. The method of claim 29 wherein said olefinic monomers are ethylene, propylene and 1-butene.

42. The method of claim 29 wherein said olefinic monomers are *n*-butyl acrylate and *t*-butyl acrylate.

43. The method of claim 29 wherein said olefinic monomers are  
5 ethylene and *n*-butyl acrylate.

44. The method of claim 29 wherein said olefinic monomers are  
ethylene and *t*-butyl acrylate.